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JULIE BILLINGSLEY
TEAM LEADER EXAMINATION
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The present invention addresses certain deficiencies and or makes improvements in closures and co-operating container necks and co-operating cups or receptacles attached or removably attached to the closures.

The present invention deals especially with the need for a proper relationship between sealing means and tamper evidence means such that the tamper evidence means operates prior to the seal being breached. This avoids the possibility apparent with many so-called tamper evident closures whereby by malicious tampering or inappropriate application torque and/or relaxation of the closure causing the seal between closure and container neck to be breached without the tamper evidence means operating and allowing the contents to be degraded by action of atmosphere or malicious introduction of contaminants.

One aspect of the present invention is a closure and closure mould assembly and a corresponding container neck and the following example is a non-limiting example.

The neck 100 in Fig 4 consisting

an outer 105 wall having

one or more external threads 110 which co-operate with a corresponding internal thread or threads on the closure. In the case of multi start threads the thread profile may be of narrower profile on both neck and closure to allow for the axial or push-on application of the closure to the container and the threads may be continuous or segmented as required. In the case of containers for carbonated beverages the threads 110 must co-operate with the closure threads to retain the closure on the neck whilst the pressurised gas vents. To accomplish this the threads of one or more of the closure or the container neck may be slotted or segmented to facilitate release of the gas and

a tamper bead 115 with a face 116 to co-operatively engage with the tamper evidence ring or tamper evidence engagement means on the closure the tamper bead may be advantageously segmented with equal spaced gaps 'Y' to reduce the quantity of material required and

one or more ramped angled projections 120 below the tamper bead shaped such that ramped surfaces 126 allow corresponding ramped surfaces on the closure to pass over when applying the closure to the container neck but upon rotation to remove the closure engagement surfaces 122 engage with corresponding engagement surfaces on the closure thereby promoting early breakage of the frangible bridges and separation of the tamper ring from the skirt of the closure as described below

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an inner wall 130

a top wall 135 joining the outer and inner walls

the closure 10 in Fig 3A consisting

a disc 20 with an upper wall and a lower wall 13 and depending from the lower wall

one or more sealing means including but not limited to annular sealing means depending from the lower wall of the closure disc and/or the inner wall of the closure skirt or any combination thereof and such sealing means to sealingly engage

In such manner as to create a seal between closure and container that will have at least one sealing means operating until the tamper evident ring is substantially separated from the closure skirt thus giving clear evidence of the seal being breached.

with any one or more of or in any combination of

the inside wall 130 of the container neck by annular ring 40

the top wall 135 of the container neck by annular device 41 or 43

the outer wall 105 of the container neck by annular device 41 or 43

one or more retention means 42 to retain for example a cup or receptacle or disc or device (not shown) within the closure or depending from the closure. Such retention means may include but is not limited to one or more of clips, projections, recesses, rings, annular flange, interrupted or segmented annular flange annular groove or recess interrupted or segmented annular groove or recess depending from the lower wall of the closure disc 20 such that an object such as a cup may be engaged with the retaining means such that the cup is held in position whilst the closure is sealingly engaged with a corresponding container but the cup may be removed to access the contents (such as food or beverage additives) contained in the cup. Such retention means being for example but not limited to one or more of clips, projections, recesses, rings, annular flange, interrupted or segmented annular flange annular groove or recess interrupted or segmented annular groove or recess

a skirt 30 the skirt having

an inner wall with a raised thread which co-operates with the external thread on the neck of the container

an outer wall which may have raised areas to co-operate with;
means to apply the closure to the container neck and or
means to eject the closure from a mould.

a lower wall between the tamper evidence means and the skirt the lower wall having

a tamper evidence ring 55 depending from the lower wall by means of frangible bridges 50 the ring having any one or more of and in any combination thereof which combination may omit one or more of

an outside wall

an inside wall

an end wall 59

collectively shaped to provide and/or be manipulated to provide means of ejection from the mould or/and or engagement means with the tamper bead on the neck of the container such engagement means 58 consisting of but not limited to any one or more of and in any combination thereof which combination may omit one or more of

a ramped projection which is shaped to more easily pass over the tamper bead on the neck of the container on application of the closure but also shaped that upon removal of the closure from the container the projections engage with corresponding surface on the container neck promoting early breakage of the frangible bridges and separation of the tamper ring from the skirt of the closure.

a folded flap or flap 58 which may be folded after moulding and which may be thicker at one end than the other and may have stiffening ridges thereon and which may be shaped to facilitate folding such flap may be advantageously moulded in a position where end 59 is closer to the axis or centre of the closure to ensure that when folded into the closure the flap will tend to be in a position to engage with in FIG. 5 both the wall 105 and the and engagement faces 116 and 118.

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a flap shown in FIG.3 which is moulded in a position to allow one or more projections 73 to be created on the wall of the flap 68 such that when folded into position inside the closure (shown with dotted line)

the ramped surface 72 shaped to more easily pass over the tamper bead on the neck of the container upon application of the closure(not shown)and the ramped projection surface 72 shaped to easily pass over corresponding (in FIG.4) ramped surfaces 126 on projections 120 on the neck of the container below the tamper bead 115 upon application of the closure(not shown) and whereupon the closure is rotated in the direction to remove the closure from the neck of the container then the surfaces 70 and 59 of the said projections 73 respectively engages with corresponding engagement surfaces 122 and 116 on the neck of the container thereby restraining movement of the tamper ring and promoting early breakage of the frangible bridges and separation of the tamper ring from the skirt of the closure and the projection shape 74 in Partial view 2 of FIG.3 having a dimension 'X' being a dimension larger than the gaps dimension 'Y' shown in FIG. 5 in a segmented tamper bead 115 of a corresponding container neck

a projection (not shown) which may be shaped so as to engage with the tamper bead on the container neck but also shaped to assist removal from the mould and any combination of the foregoing

The mould assembly comprising first and second mould portions which co-operate to define when in a closed position, a closure cavity;

the first mould portion containing the means of injection of polyolefin material and defining or partially defining

the external features of the top disc and skirt of the closure and one or more raised features on the exterior of closure which may co-operate with closure application means or closure ejection means.

The second mould portion having one or more of and or means of co-operation between and in any combination thereof

a threaded core shaped to define any one or more of and in any combination thereof which combination may omit one or more of threads on the inner wall of the closure skirt such threads co-operating with the threads on the neck of the container

annular sealing means depending from the lower wall of the closure disc and/or the inner wall of the closure skirt or any combination thereof and such sealing means to sealingly engage with any one or more of or in any combination of
the inside wall of the container neck
the top wall of the container neck
the outer wall of the container neck

annular or interrupted annular retention means depending from the lower wall of the closure disc such that an object (such as a cup or receptacle or disc or device) may be engaged with the retaining means such that the object is held in position whilst the closure is in use or alternatively the object but may be removed to access the contents (such as food or beverage additives) of the receptacle. Such retention means for example but not limited to one or more of clips, projections, recesses, annular flange, interrupted annular flange annular groove or recess interrupted annular groove or recess

an annular support ring shaped and positioned to form one or more of or portion of and in any combination thereof which combination may omit one or more of

part of the outside wall of the skirt
a projection on the outside wall of the skirt
a shoulder defining the lower extremity of the skirt
at least a portion of the tamper evident ring
one or more frangible bridges connecting the skirt to the tamper evident ring

an outer core which co-operates with the threaded core and the support ring to define at least portion of an annular tamper evident ring and by co-operative movement relative to the support ring and the threaded core creates a space into which the tamper evident ring may deflect to assist ejection of the closure.

one or more inner cores which may be shaped to define at least portion of the one or more of and annular sealing means and or annular or interrupted annular retention means and which by collective co-operation and relative movement between the said inner cores and the threaded core assists ejection of the closure from the mould.

the inner cores and the threaded core co-operating and by relative forward or opening movement in relation to the support ring cause the closure whilst still remaining on the said inner cores and threaded core to move away from the support ring.

the inner cores and the threaded core co-operating and by relative forward or opening movement of one or more of the inner cores relative to the threaded core eject the closure off the threaded core.

Alternatively the support ring may mover forward relative to the threaded core thereby withdrawing the threaded core from the closure and further forward movement by the inner core or cores removes the closure from contact with the support ring and ejects the closure from the mould

If the closure is still retained on the inner cores by portion of the closure such as the said retention means then by co-operative forward or opening movement of the innermost core relative to the other inner core the closure may be ejected off the inner core.

The present invention includes a cup or receptacle (not shown) shaped with features which co-operate with the said retention means within the closure such means of co-operation being for example but not limited to one or more of clips, projections, recesses, annular flange, interrupted annular flange annular groove or recess interrupted annular groove or recess.

In a further non-limiting aspect of the invention suitable for use with or without cup retention means we show in Fig. 2

a tamper evident closure 10 (shown partially) with a top wall 20 and an annular sealing device 40 sealingly engaging the inside wall 65 of the container neck 60 and another annular sealing device 41 which may also but not necessarily be used to sealingly engage with either or both the upper wall 63 and the outer wall 64 of the container neck 60 (shown not fully sealingly engaged).

The design of the closure being such that when the closure is fully applied

the distance 'A' being the distance over which an interference fit and seal continues to occur between the annular sealing device 40 and the inner wall 65 of the container neck 60 during removal of the closure from the fully applied position (not shown) on the container neck and

further described as being the distance between

line A1 being the line touching the top wall 63 of the container neck and the
line A2 being the line touching point of sealing engagement between annular
sealing device 40 and the inner wall 65 of the container neck 60 measured at
the point when the closure is fully applied (not shown) to the container neck

shall be always sufficiently larger than the distance 'B' being the distance between the engagement surface 61 of the tamper bead 62 and the engagement surface 59 of the tamper ring engagement means 58 when the closure is fully applied to the container) plus

a distance 'C' (not shown) equalling the amount of compression that occurs in the tamper ring engagement means during the process of removal plus

a distance 'D' (not shown) equalling the amount of stretch that occurs under stress during closure removal in the frangible bridges 50 connecting the tamper evidence annular ring 55 to the closure skirt 30 plus

a distance 'E' (not shown) being the distance equal to the tolerance allowed in the measurement specifications of the container neck 60 and the closure 10 plus as may be required a distance for margin of safety for a particular closure and neck combination.

By observing this formula in designing a closure then the closure will be in sealing engagement with the container neck until after tamper evidence is displayed thereby ensuring that no contamination of contents can occur without tamper evidence.

The foregoing inventions may be adapted according to the following procedure for closures using sealing methods other than that described in the foregoing example of closures with a bore seal on the inside neck surface of the container.

Where closures seal by other than a bore-seal the distance 'G' over which the seal is effectively in contact with the neck of the container expressed as the number of removal rotations or portion of a rotation of the closure during removal is substantially less than distance 'A' referred to in the bore-seal example in

FIG. 2

To compensate for this the tamper evidence feature must be caused to operate promptly upon removal rotation of the closure.

Referring to FIG. 3 The present invention is designed to restrain the movement of the tamper evident ring 55 on the closure by including co-operating engagement means 58 on the tamper evident ring and engagement means 115 on the container neck (shown in FIG. 4) such that upon removal rotation the said co-operating engagement means engage and further removal rotation fractures the frangible bridges 50 separating the tamper evidence ring 55 from the closure skirt 30. The present invention including container necks is described in the following non-limiting examples

Referring to FIG. 3. Partial View 1. shows the lower edge 59 of tamper evident engagement means 58 with protrusions 73 having engagement faces 70 and ramped surfaces 72. The protrusions are spaced around the whole of the lower portion (as moulded) of the tamper evident engagement means 58 with the protrusions 73 protruding in the direction 'B' such that when the tamper evident engagement means 58 is folded into the closure (shown with dotted line then the protrusions are oriented to upon rotation of the closure in the direction of removal engage with (shown in FIG. 4.) the corresponding neck engagement means 115 and 120 on the container neck. The neck engagement means 115 have engagement faces 116 to restrain axial movement and engagement faces 122 to restrain rotational movement of the tamper evidence ring 55 and upon further removal rotation of the closure sever the frangible bridges 50 and

Partial View 2 shows an alternative configuration of protrusions 73 and 74 which are designed to co-operate with as shown in FIG. 5 and FIG. 4 or a combination of FIG. 4 and FIG. 5 such that the distance 'X' on protrusion 74 is greater than the distance 'Y' shown in FIG. 6 thus preventing protrusion 74 from passing through the gap 'Y' in the tamper bead 115 and retaining the tamper band 55 on the neck of the container.

Partial View 3. shows a corresponding view of Partial View 1 as seen from location 'B'.

Referring to FIG.3A Partial View 4 is a view from location 'B' showing protrusions 76 extending from the lower edge 59 of tamper evidence engagement means 58 to form a series of tooth like engagement devices 76 having engagement faces 70 and ramped surfaces 72 and first engagement points 75 which are designed upon removal rotation to progressively engage (shown in FIG. 5) with corresponding engagement faces 116 and 118.

Partial View 5 is a perspective view from the direction 'C' showing the tamper evident engagement means 58 folded inside the closure. As can be seen the engagement faces 70 will be able to engage both of the corresponding neck engagement means 116 and 118 (shown in FIG. 5) and the face of the tamper evidence engagement means 58 which passes over the tamper bead 115 upon application has no projections thereon

and will by deflecting outwardly towards the outside of the closure. In the event that the surfaces 72 abut the corresponding opposite surface of engagement face 116 on the container tamper bead 115 during the passing of the tamper evidence engagement means 58 over the tamper bead 115 then the ramped shapes of surface 72 will assist.

The corresponding formula for non bore-seal or shallow bore-seal closures is
The distance 'G' which is the distance represented by that fraction of a turn in the direction of removal which must always be less than

the distance 'H' (not shown) being the corresponding rotational measurement to distance 'B' (in the bore-seal formula) this dimension as may be required also takes into account during the closure design stage of the compression of the sealing means against the upper surface 135 of the container neck plus

the distance 'I' (not shown) which is the fraction of a rotation necessary to present engagement faces 70 and engagement points 75 on the tamper ring against corresponding engagement faces 116 and 118 on the container neck plus

the distance 'J' (not shown) being the corresponding rotational measurement to distance 'C' (in the bore-seal formula). This number can be minimised through the addition of stiffening ribs or ridges and/or use of more rigid plastics
plus

the distance 'K' (not shown) being the corresponding rotational measurement to distance 'D' (in the bore-seal formula) plus

the distance 'L' (not shown) being the corresponding rotational measurement to distance 'E' (in the bore-seal formula).

Now referring to the FIG.3 A we disclose
that the retention device 42 may usefully be located further away from the skirt of the closure especially in closures of larger diameter.

the retention device 42 is also not limited to the shape shown but may be shaped to correspond with the cup or container or device being retained (not shown) which may also be shaped such that one or more of or combination of co-operating clips, projections, recesses, annular flange, segmented or interrupted annular flange, annular groove or recess, interrupted annular recess and said cup and retention means 42 may be advantageously designed for example with a chamfered flange on the cup so that the cup is easily fitted into the retaining means 42 and this assembly may usefully be combined in a closure with the sealing means 41 or its mirror image 43 shown with dotted line.

Referring to FIG.3 A We hereby disclose a design for sealing means 41 and or 43 which may advantageously be constructed with the cross sectional dimension decreasing progressively from the point of joining with the lower wall 13 of the closure disc 20 and the said point of joining having a radius (not shown) such that the over all design of sealing means 41 and or 43 facilitates easy removal from a mould assembly (not shown)

the features 41 42 and 43 may also be shaped advantageously according to known means.

Referring to FIG. 6 and FIG. 7 showing a view from above the container neck of container necks to correspond with the closures disclosed herein and the quadrants Q1, Q2, Q3, Q4 are as follows

In FIG.8 all 4 quadrants are similar.

In FIG. 7 Q2 is the mirror of Q1 and the half Q3 and Q4 is the mirror image of the other half Q1 Q2. The interruptions or gaps 'Y' in the tamper bead 115 may be shaped differently according to the means of manufacture or desire to minimise the amount of material used. The relationship of gaps 'Y' to segments 'Z' may usefully be varied to save material for example by making the dimension ratio 3Y to 2Z resulting in a material saving is in the order of 60% of the material used in a solid tamper bead and such container necks and tamper beads can be designed so as to operate with other closures

The present invention includes any one or more of the aspects disclosed herein incorporated with the mould assembly and closures disclosed in US Patents 6,551,093 and 6,626,310 and 6,640,988 and the subject matter thereof is hereby incorporated herein

The present inventions extend to any one more of the foregoing disclosed aspects combined with or used in conjunction with the following closure types and corresponding containers in any combination thereof

child resistant closures and

dispensing closures such as but not limited to push pull valve, disc top actuator, slit valve screw opening valve.

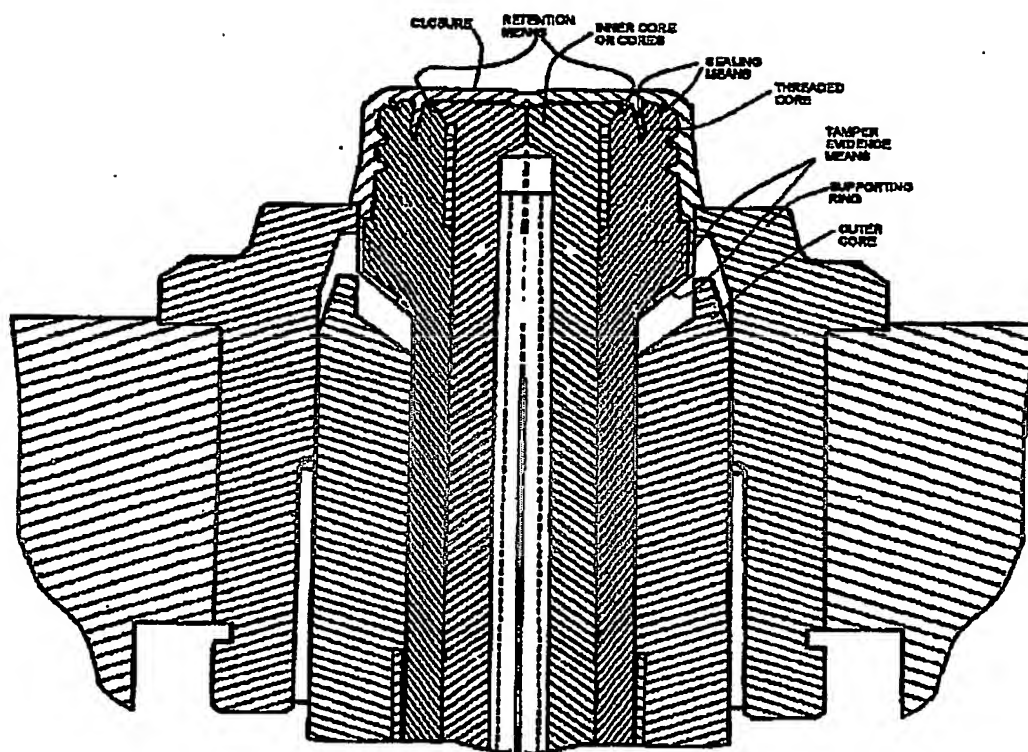
push-on screw off closures

Persons skilled in the art may discover alternate versions of these closure systems without departing from the present invention.

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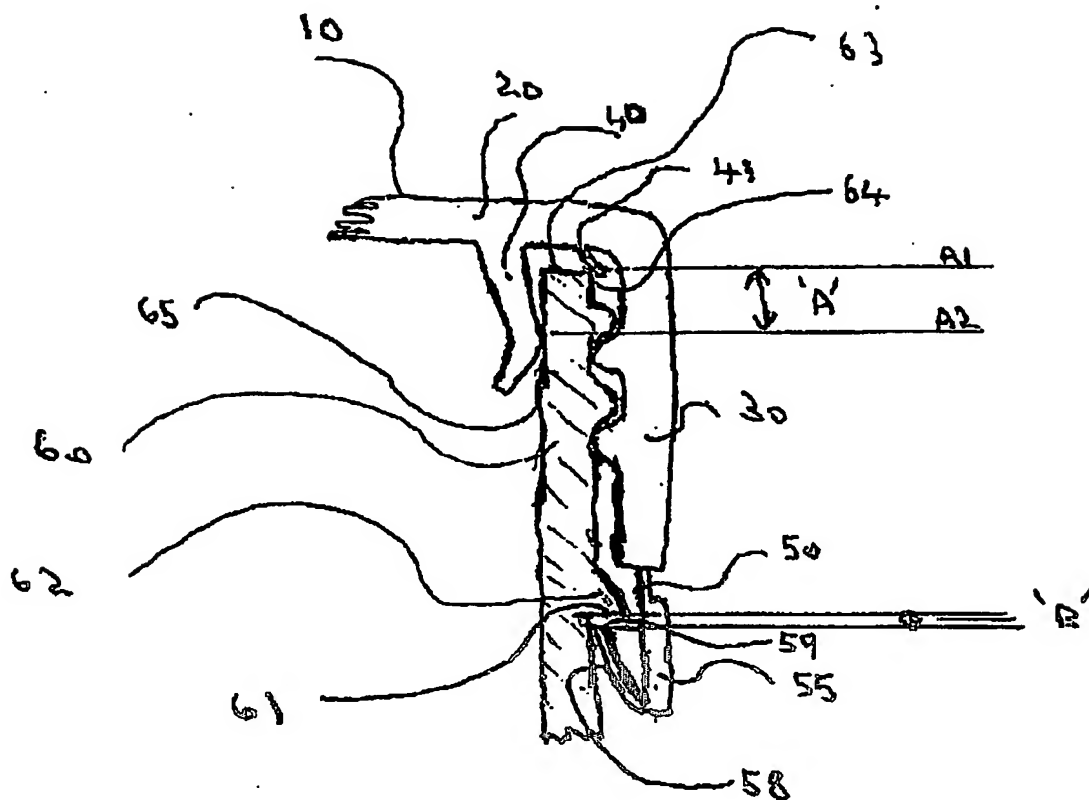
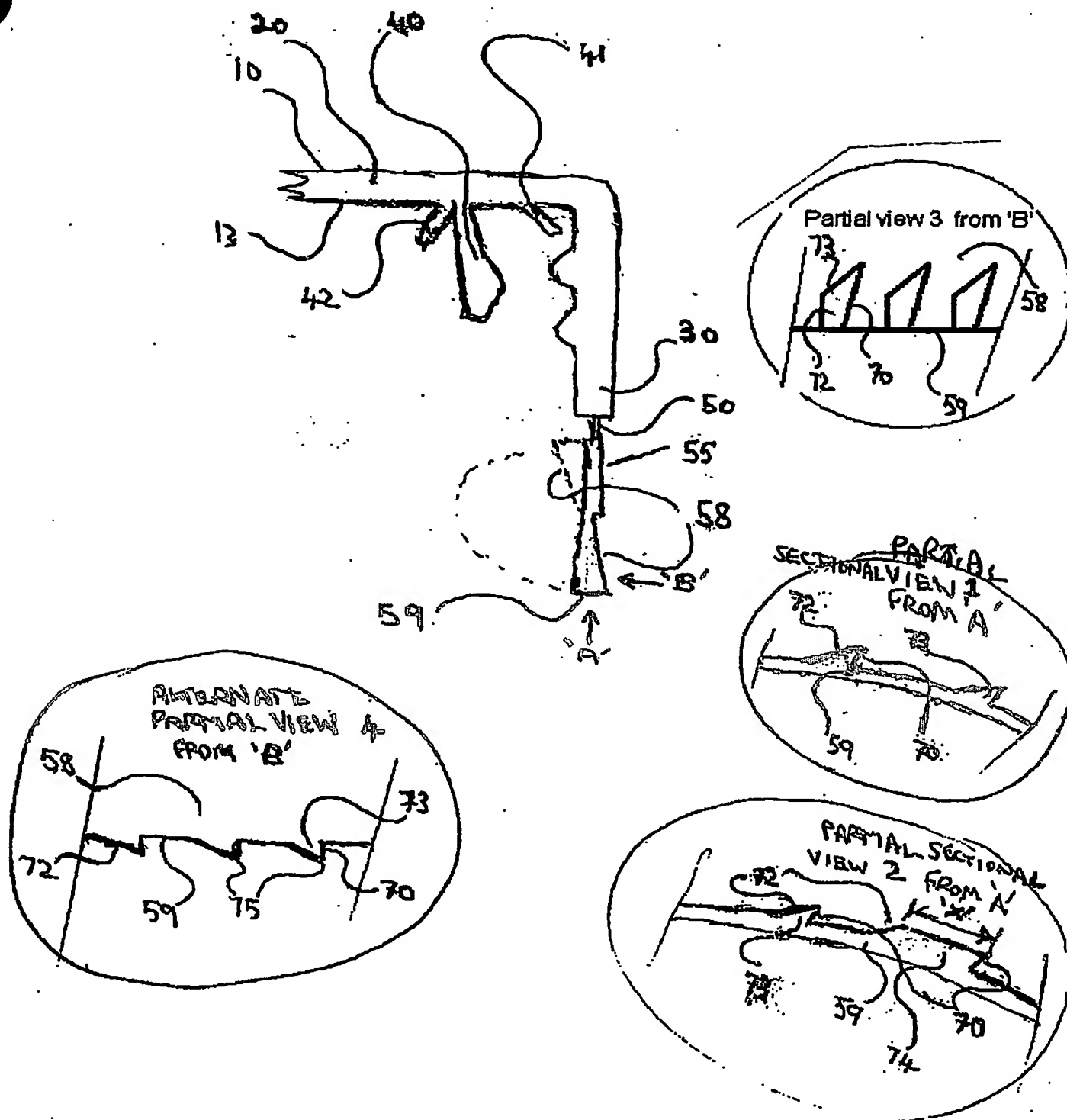


FIG 2.



NON LIMITING EXAMPLE

FIG 3

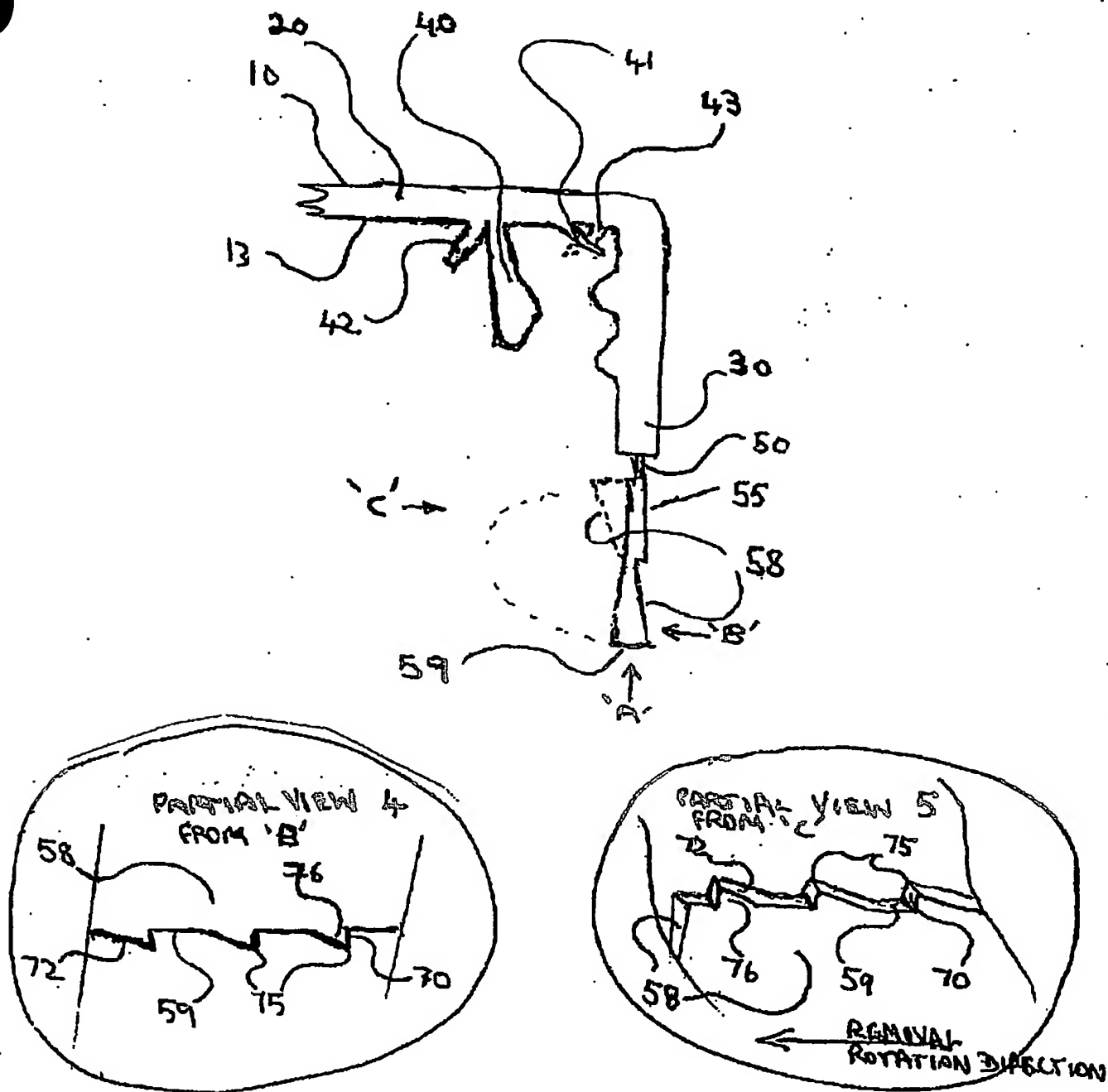


FIG. 3 A

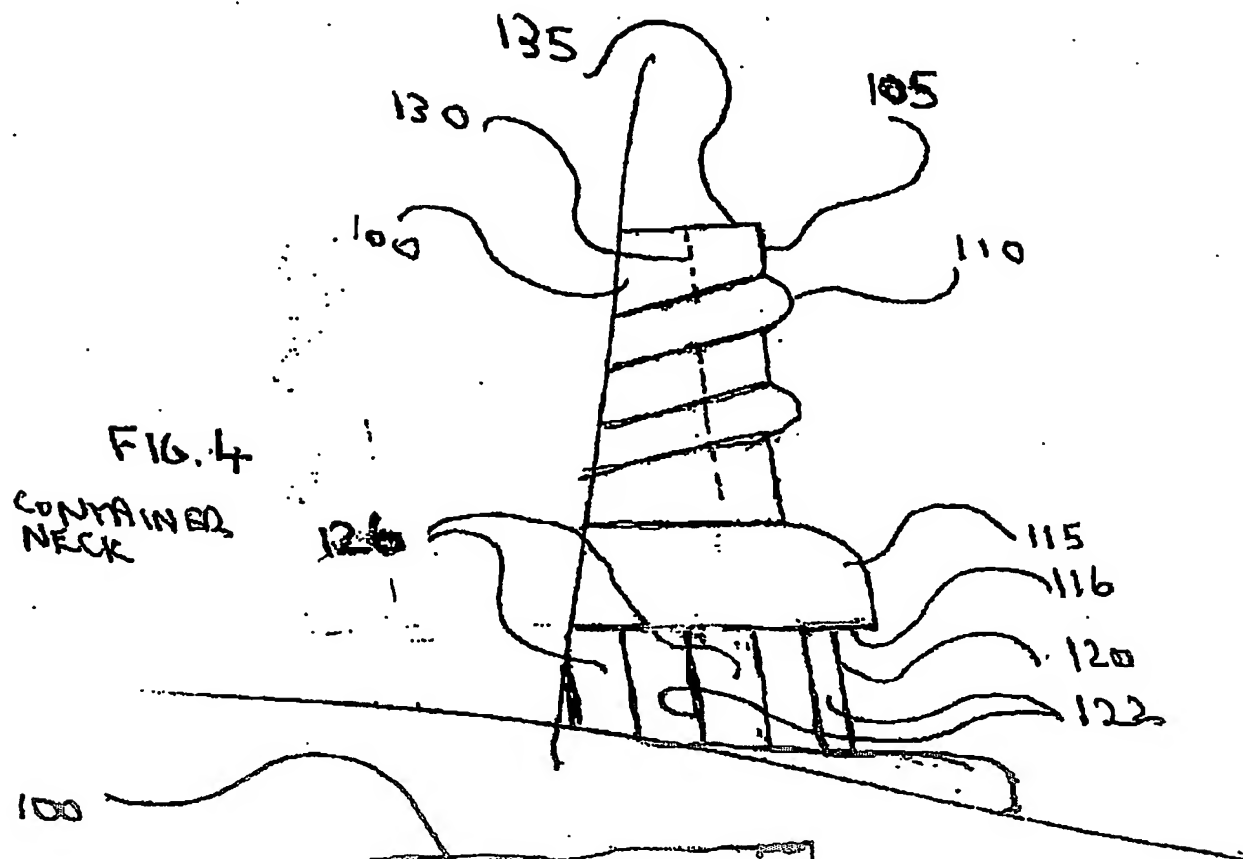


FIG 5
CONTAINER NECK

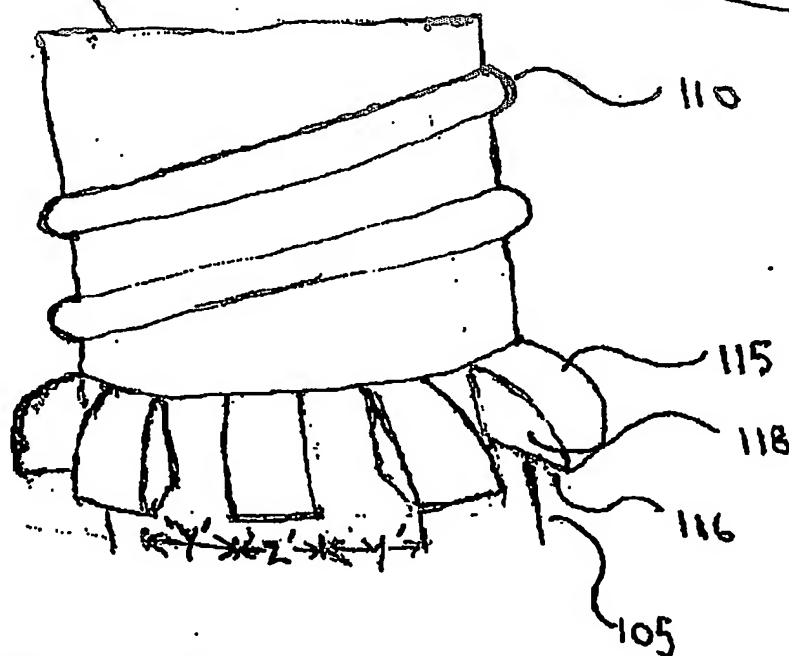


FIG. 6.

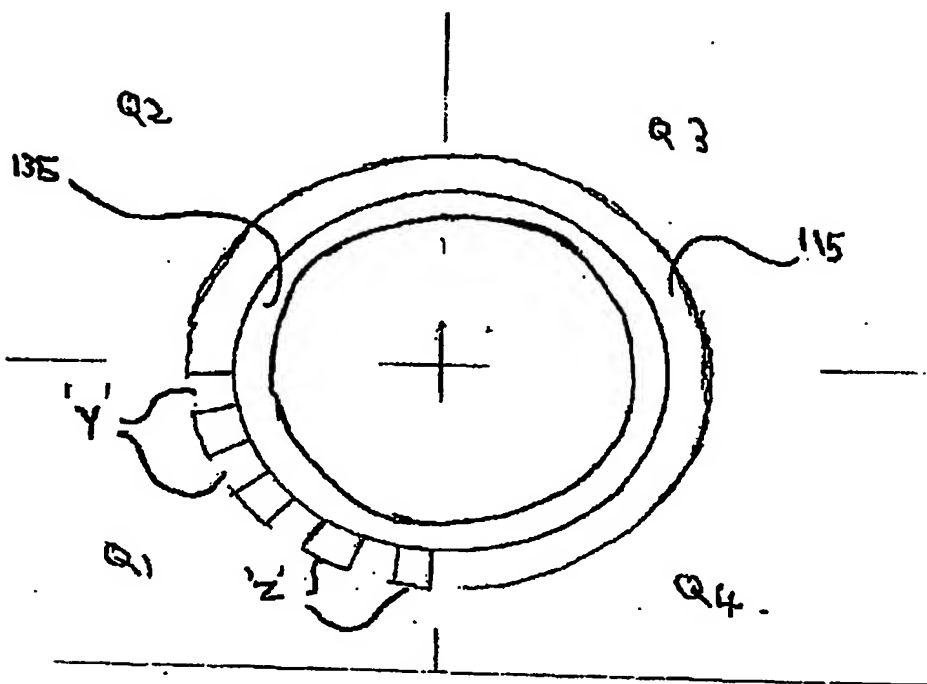
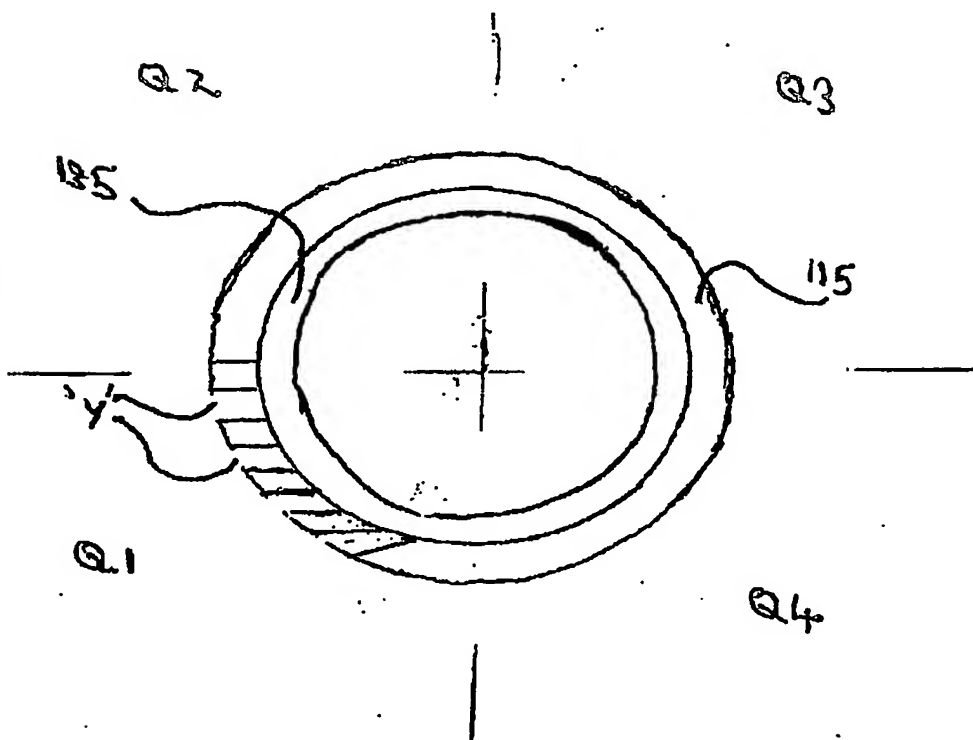


FIG. 7.



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